



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION VI  
1445 Ross Avenue  
Dallas, TX 75202

August 22, 2012

CERTIFIED MAIL-RETURN RECEIPT REQUESTED

Ms. Jean A. Mescher, Project Coordinator  
Director Environmental Services  
McKesson Corporation  
One Post Street, 34<sup>th</sup> Floor  
San Francisco, CA 94104

RE: Groundwater Remediation  
Arkwood, Inc. Superfund Site

Dear Ms. Mescher,

This letter provides the U.S. Environmental Protection Agency (EPA) direction for the path forward on groundwater remediation activities at the Arkwood, Inc. Superfund Site. From June 2012, comments on the status of groundwater remediation were solicited by EPA Region 6 and received from McKesson Corporation (McKesson), Arkansas Department of Environmental Quality (ADEQ), and EPA Office of Research and Development (ORD). These comments resulted in a joint McKesson-EPA-ADEQ conference call on August 1, 2012. Following this call, two additional responses were received and are enclosed with this letter.

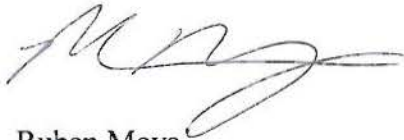
The EPA direction for the path forward on groundwater remediation activities at the Arkwood, Inc. Superfund Site are as follows:

- 1) Operation of the pilot injection system is to be ceased in the month of September 2012. This cessation of operations is expected prior to any required monitoring in the month of September 2012.
- 2) Starting from September 2012, required monitoring is to continue on a monthly basis, with additional collection of temperature, pH, and dissolved oxygen measurements. Monitoring will continue until EPA, with ADEQ consultation, deems that such monitoring will no longer be needed.
- 3) EPA has continued concerns on the fate and transport of Pentachlorophenol (PCP) contaminated groundwater from the site. These concerns (detailed in Enclosure 2) arise from the review of the previous 1991 dye tracing study, as well as the lack of

groundwater monitoring other than at the mouth and weir at New Cricket Spring. McKesson is directed to submit a proposal in September 2012 that details the steps that will be taken to alleviate these concerns.

I look forward to continued efforts to bring site groundwater remediation activities to conclusion. If there are any questions, please feel free to contact me by telephone at 214.665.2755, or via email at [moya.ruben@epa.gov](mailto:moya.ruben@epa.gov).

Sincerely,

A handwritten signature in black ink, appearing to read 'RMoya', with a long horizontal flourish extending to the right.

Ruben Moya  
Remedial Project Manager

Enclosures (2)

Enclosure (1): Arkwood 8-9-2012-Responses to Comments  
Enclosure (2): 2012\_8\_15\_Dye Tracer Test\_Critical Review\_2012

cc: Mark Moix, ADEQ

**Certified Mail**

August 9, 2012

Mr. Stephen Tzhone, Superfund Remedial Project Manager  
Superfund AR/LA Enforcement Section (6SF-RA)  
U.S. Environmental Protection Agency  
1445 Ross Avenue  
Dallas, Texas 75202

**Subject: Groundwater Remediation Summary  
Response to Comments**

Dear Mr. Tzhone:

This letter provides responses to the USEPA and ADEQ comments on the Groundwater Remediation Summary dated June 2012 prepared by McKesson for the Arkwood, Inc. Superfund Site. The agency comments are presented below followed by McKesson's responses in italics. A revised Groundwater Remediation Summary is attached in redline and clean versions which incorporate agency comments as appropriate.

A conference call was held on August 1, 2012 to discuss the comments and to provide background information to those who only recently became involved in this project. Some of the comments were addressed by providing this background information and further clarifications about the Arkwood site as detailed in our responses below.

**ADEQ Comments dated July 13, 2012:**

- 1) **Conclusions and Recommendations, p.9:** In February 2012, ADEQ sent to EPA a letter with recalculated water quality standards for New Cricket Spring. These limits should be referenced in the proposed recommendations. The text describes these values as cleanup standards. ADEQ recommends in the sixth sentence of the section "Based on the Arkansas Pollution Control and Ecology Commission's water quality standard for pentachlorophenol (PCP) presented by ADEQ in their February 14, 2012 letter, the chronic standard of 15.57 µg/l is the appropriate standard for the Arkwood Site." The appropriate standard for this stream is the chronic standard 15.57 µg/l. The organisms in the receiving stream experience long term exposure to PCP; therefore the chronic standard is most appropriate. ADEQ also recommends monthly monitoring of PCP for the next five year period. Because of the typically large fluctuation in the flow at the spring, quarterly sampling may not be an adequate representation of the PCP level in the short term. Because the spring is now physically restricted from contact, any proposal to remove this barrier may need to be reevaluated for potential risk as a drinking water source.

**Response:** *The recommended change to the sixth sentence of the Summary will be made. As discussed in our conference call on August 1, 2012, monthly monitoring for five years may be excessive; however, McKesson will continue conducting monthly monitoring of New Cricket Spring and the treatment system effluent for at least a year, at which time McKesson will provide a summary of data and may petition for a change in frequency or discontinuation of monitoring. To clarify the status of the current physical restriction to the spring, McKesson owns the spring and adjacent property and does not currently propose to remove the barrier around New Cricket Spring and the treatment building.*

- 2) The attached letter also includes a request for measuring additional parameters during each monthly sampling event at the mouth of the spring. These parameters include the temperature, pH and dissolved oxygen of the spring water.

**Response:** *McKesson agrees to collect temperature, pH and dissolved oxygen measurements at New Cricket Spring during monthly sampling events for at least a year, at which time McKesson will provide a summary of data and may petition for a change in frequency or discontinuation of such monitoring.*

**USEPA Comments dated June 27, 2012:**  
**Technical Review Comments and Recommendations**  
**General Comments**

1. It was reported that,

“A pilot water injection system was installed in late 2005 at the Site. The pilot system was designed to inject groundwater or ozonated groundwater into the subsurface beneath the Arkwood Site to a depth of approximately 25 feet to maintain adequate flow through the spring and to treat residual concentrations of PCP that impact New Cricket Spring.”

The primary objective of the Arkwood site ozone treatment system is unclear. In general, the use of ozone in engineered systems is a good oxidant to use to treat PCP and PAH wastes resulting from wood preserving operations. However, the extraction of ground water at the Arkwood site (from the source area), ozonation, and subsequent injection into the subsurface is likely (1) to have good impact on contaminants in the extracted/treated water, but (2) is projected to have limited impact on the treatment of contaminants in the subsurface in the source area. Once injected, ozone depletion in the injected water is rapid and will occur within a very short transport distance from where it is injected. Ozone would therefore have a strong influence over a very short distance from where it was injected (perhaps a few feet, or less), but would have limited/negligible impact beyond this very narrow radial influence. This conceptual model is proposed based on the very high reactivity of ozone, the abundance of reactants in the subsurface systems, and the relatively limited mass of ozone that can be dissolved in the water (and subsequently injected). This matter is covered in detail in the following US EPA Issue Paper

that can be downloaded from the EPA GWERD website (<http://www.epa.gov/nrmrl/gwerd/publications.html#oxidation>).

Huling, S.G. and B. Pivetz. 2006. "In-Situ Chemical Oxidation – Engineering Issue". US Environmental Protection Agency, National Risk Management Research Laboratory, R.S. Kerr Environmental Research Center, Ada, OK. EPA/600/R-06/072.

Assuming the treatment objective was to achieve significant contaminant mass reductions in the Arkwood source area, other more aggressive remedial technologies, including in-situ chemical oxidation (ISCO) is recommended. This would require a focused feasibility study to identify and select a remedial technology capable of achieving the treatment objectives.

In the correspondence from the Arkansas DEQ (letter dated April 4, 2011), it was reported that the EPA Region 6 screening table indicates that the concentration of PCP in the soil at industrial sites is 2.7 mg/kg. Assuming PCP concentrations at the Arkwood site are greater than this level, additional treatment at the site may be required and a more aggressive approach is needed (as suggested above).

**Response:** *It appears that Dr. Huling, who authored the USEPA comments dated June 27, 2012, made his comments based on the 2011 Annual Report and may not have had the "Arkwood, Inc. Superfund Site Groundwater Remediation Summary" dated June 2012 at his disposal to aid in his review. A copy of this latter report (revised as a redline and a clean version) is attached for reference. As noted in that Summary, the primary objective of the pilot ozone treatment system was to expedite cleanup of New Cricket Spring. Similarly, the Third Five-Year Review issued by EPA in July 2011 notes that "An ozone injection pilot study was operated from December 2005 through August 2009 with the goal of accelerating the reduction of residual PCP in the subsurface beneath the Site and New Cricket Spring." This objective of the pilot ozone injection system was discussed further in the August 1, 2012 conference call between ADEQ, EPA and McKesson representatives. As discussed, McKesson proposed and volunteered to conduct this pilot injection system. The pilot injection system was operated as an addition to the main treatment system located at the mouth of New Cricket Spring. As required by the Record of Decision (ROD), the main treatment system was installed at the mouth of New Cricket Spring in 1997 and continues to operate in compliance with Arkansas treatment standards.*

*It was also clarified during the August 1, 2012 conference call that the water used for pilot injection is extracted from a deep (>500 feet) onsite well, was ozonated (until 2009), and is injected on the main Site near the former sinkhole area. While Dr. Huling's concerns regarding the potential for rapid ozone depletion within a short distance would be valid at many sites, the hydraulic flow characteristics for the Arkwood Site indicate that flow occurring between the Site and New Cricket Spring occurs mainly via conduit flow through the fracture system. As a result, during operation of the pilot ozone injection system, ozone was detected emanating from the mouth of New Cricket Spring under certain operating conditions, confirming it was not subject to the rapid depletion of concern to Dr. Huling. Thus, the goal of the pilot injection system, to distribute ozone to the subsurface fracture system as a means of oxidizing and reducing residual PCP concentrations that may be present in the fractures due to varying flow conditions, was accomplished.*

2. It is assumed that the cleanup goal is to treat water that emanates from New Cricket Spring only using ozone and to release the treated water to Cricket Creek. It is proposed, but clearly not confirmed, that PCP-contaminated ground water, emanating from the contaminated site, is not captured by New Cricket Spring and migrates beyond New Cricket Spring in the ground water. Assuming this is acceptable to EPA Region 6 and the Arkansas DEQ, additional work is not recommended. However, if contaminated ground water bypassing New Cricket Spring represents unacceptable exposure pathways and risk, it is recommended that additional site characterization and a fate and transport investigation be conducted to assess the extent to which this condition may be occurring.

**Response:** *A dye tracing study was completed for the Site in 1991 (Final Report, Groundwater Tracing Investigation, Arkwood, Inc. Site, Omaha, AR dated September 21, 1992). Based on the Remedial Investigation and dye study results, three private wells (W-9, W-11A and W-11B) and four springs (New Cricket Spring, Cricket Creek Spring, Railroad Tunnel Spring and Walnut Creek Spring) were selected for monitoring. Since no dye and no PCP were detected in the private wells, these wells were later removed from the monitoring program when the municipal water line was installed. A request to eliminate sampling of Cricket Creek Spring, Railroad Tunnel Spring and Walnut Creek Spring was submitted in 2000 since no PCP was detected in any of the three springs after January 1997. Water from New Cricket Spring continues to be monitored and treated before being released. Although a portion of the water that flows beneath the Arkwood Site may not flow through New Cricket Spring, no detectable PCP concentrations are measurable at other potential discharge locations.*

3. An assessment of the ground water quality at New Cricket Spring as a function of (1) ozone treated and injected water at the Arkwood site, (2) untreated injected water at the Arkwood site, and (3) no treatment or injection of water at the Arkwood site, is a complex matter. One approach to assess this issue would be to compare PCP concentrations in the ground water emanating at New Cricket Spring during the years when ozone treatment was being performed (2005-2011), relative to the recent untreated periods (2011-2012), and before 2005 when no treatment or injected water was occurring. Due to fluctuations in the flow at New Cricket Spring, variability in PCP concentrations at New Cricket Spring, variation in rainfall, variability in the direct hydraulic connection between the two locations (TBD), and several other significant fate and transport factors/parameters, this analysis will be difficult and definitive conclusions doubtful. The use of intermediate ground water wells located between New Cricket Spring and the Arkwood Site where the treated/untreated water is injected (or not injected), could provide insight on this matter. A critical analysis of this issue would also benefit from other site characterization tools including a tracer testing, aquifer testing, etc.

**Response:** *We believe that the questions raised by Dr. Huling in this comment were addressed during our August 1, 2012 conference call and with the additional data provided, including the dye tracing study. For reference, the ROD states, "Shallow ground water on the site is contaminated with PCP. Only one spring in the area, New Cricket Spring, which lies approximately 1,000 feet northwest of the site, has consistently shown contamination with PCP. No drinking water wells have been shown [to be affected by] the presence of site contaminants.*

*The area is underlain by karst geology which prevents the use of monitor wells as a method of predicting contaminant movement, or recovery wells as a method of remediation. Therefore, ground water remediation focuses on New Cricket Spring." ROD, Declaration, p.2. We agree that it is impossible to determine with any precision the impact of the pilot injection system operations on the residual PCP due to the significant variations in flow at New Cricket Spring and the complexity of karst geology; however, it is undisputed that the concentration of PCP at New Cricket Spring has decreased significantly from 1989 (when it exceeded 1,000 µg/l) to the concentrations measured in the more recent years (5-50 µg/l range), which approach the Arkansas chronic standard of 15.57 µg/l. McKesson believes this reduction is at least partially attributable to the years when ozone treatment was being performed (2005-2009), as confirmed by the generally decreasing approximate annual average PCP concentration trend between 2005-09 (116 ppb to 16 ppb) noted in the Groundwater Remediation Summary (p. 4).*

### **Specific Comments**

1. Based on data included in Appendix A, there does not appear to be a correlation between flow rate in the New Cricket Spring during 2011 and the concentration of PCP that is measured in the water at New Cricket Spring. However, Table 4.1 indicates that there is long term average flow rate data, and presumably PCP ground water data for New Cricket Spring that can be contrasted to assess a potential correlation. It is recommended that such an analysis be performed and include mass flux computations (flow rate x concentration) and other potential correlations.

**Response:** *We agree that the PCP concentrations measured at New Cricket Spring continue to exhibit a certain amount of variability while overall concentrations have been reduced significantly. It is our recommendation that the pilot injection program be discontinued so that natural spring flow and unaffected PCP concentrations and variability can be measured at New Cricket Spring.*

2. Based on the area encompassed by the Arkwood site (Figure 1) and the downgradient location of New Cricket Spring, it is doubtful that all the water that passes through/under the Arkwood site emanates (captured) in the New Cricket Spring. Consequently, contaminated water may be bypassing New Cricket Spring and discharging to Cricket Spring elsewhere. In conjunction with general comment no. 2 above, it is recommended that this issue be investigated further.

**Response:** *As stated above, we agree that a portion of the flow that passes beneath the Arkwood Site may not discharge to New Cricket Spring; however, no detectable PCP concentrations are measurable at other potential discharge locations. This issue was evaluated during the RI and dye tracing study. Accordingly, we do not believe further investigation is necessary.*

I certify that the information contained in or accompanying this submission is true, accurate, and complete to the best of my knowledge, information and belief, and that I, as project coordinator, have made reasonable inquiry into its veracity.

If you have any questions regarding these responses to comments, please do not hesitate to contact me at (608) 848-4134.

Sincerely,



Jean A. Mescher, Project Coordinator  
Director, Environmental Services

Enclosure

Copy:

- Dianna Kilburn, ADEQ\*
- EPA Assistant Regional Counsel (6C-WA)\* (w/o enclosure)
- Chief, Superfund Enforcement Branch (6H-E)\* (w/o enclosure)

\* CERTIFIED MAIL

Arkwood, Inc. Superfund Site  
Groundwater Remediation Summary  
June 2012 (Revised August 2012)

## Site History/Record of Decision

The Arkwood, Inc. Superfund Site (Arkwood Site or Site) is a former wood treating site where wood treating fluids contaminated the soil and groundwater. The Site is located in Omaha, AR. The Site was developed in the 1950's when a railroad company excavated about 40 to 50 feet below natural grade to obtain fill dirt for constructing a railroad embankment. Arkwood, Inc. began wood treating operations at the Site in 1962 using creosote and pentachlorophenol (PCP) in its process.

In 1973, the site owner leased the wood-treating facility to Mass Merchandisers, Inc. (MMI). MMI continued to operate the Arkwood plant until June 1984. Subsequently, the remaining inventory was sold or removed from the site. In January 1985, MMI's lease expired and was not renewed. The owner dismantled the plant in 1986.

In 1985, EPA proposed that the Site be added to the National Priorities List (NPL). The Site was formally added to the NPL on March 31, 1989.

With EPA oversight, MMI conducted a Remedial Investigation and Feasibility Study (RI/FS) between 1987 and 1990 pursuant to an Administrative Order on Consent (AOC). The Regional Administrator of EPA Region VI approved the Record of Decision (ROD) for the Site on September 28, 1990.

The 1990 ROD documented that the principle threat from the Site was direct contact with soils contaminated above health-based levels. In addition, the 1990 ROD stated that these soils posed a long-term threat to groundwater. Site soils were affected with pentachlorophenol (PCP), polynuclear aromatic hydrocarbons (PNAs), and dioxin. Affected materials were defined as "all Site materials that contain greater than 300 mg/kg PCP, greater than 20 µg/kg dioxin as 2,3,7,8-TCDD equivalents (dioxin), or greater than 6.0 mg/kg carcinogenic polynuclear aromatic hydrocarbons (c-PNAs) as benzo-a-pyrene equivalents". The groundwater exits at New Cricket Spring which is located about one-quarter mile downgradient of the wood treating area. New Cricket Spring contained concentrations of PCP above the Arkansas Water Quality Standard.

In April 1991, a Consent Decree (CD) was entered between the United States of America, on behalf of the USEPA, and MMI to remediate the Site. The CD includes the ROD and a Statement of Work (SOW) as Appendices A and B, respectively, (collectively the Consent Decree). A corrected CD was entered on September 23, 1992, including the same attachments.

The soil remedy was implemented in 1994 and 1995. The remediation area is fenced with signs and locked gates.

## Post Soil Remediation Spring Sampling

As set forth in the CD and based on the results of a Dye Tracing Study, spring sampling was conducted quarterly for two years after the soil remediation was completed (Table 1).

Table 1 Post Soil Remediation Spring Sampling		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (ug/L)
7/2/1996	112	688
10/11/1996	2	651
1/20/1997	34	681
3/16/1997	34	330
7/18/1997	2	775
9/30/1997	50	560

## New Cricket Spring Treatment System

Since the PCP concentration at New Cricket Spring exceeded the cleanup level for PCP of 9.3 micrograms per liter ( $\mu\text{g/l}$  or ppb) monthly average and 18.7  $\mu\text{g/l}$  daily average set by Arkansas Department of Pollution Control & Ecology (ADPCE) at that time, an ozone pilot system was installed in April 1997. Data was collected during varying flow events and equipment settings. Based on the results, the treatment system was upgraded during November 1997 through January 1998 and a new, higher capacity system was installed during October through December 1999. The upgraded system continued to operate and to meet ADPCE requirements. Regular evaluation of the analytical data indicated the concentrations observed at the New Cricket Spring had plateaued at between approximately 75-150 ppb by 2004 (Table 2).

Table 2 New Cricket Spring Remediation Sampling (1998-2004)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (ug/L)
1/20/1998	42	561
5/7/1998	65	196
7/23/1998	3	561
11/4/1998	8	570
1/29/1999	60	288
7/12/1999	42	ND
3/8/2000	5	284
5/15/2000	2	272
6/23/2000	75	389
7/28/2000	3	627

8/20/2000	2	424
9/25/2000	1	577
10/26/2000	1	114
11/27/2000	25	632
2/26/2001	3	338
3/13/2001	3	376
4/27/2001	3	349
5/27/2001	2	388
7/27/2001	48	560
8/27/2001	6	372
9/27/2001	2	895
10/22/2001	6	275
11/30/2001	28	441
12/22/2001	60	114
1/28/2002	12	373
2/21/2002	15	372
3/8/2002	22	318
3/22/2002	42	226
4/22/2002	22	79
5/28/2002	70	71
6/26/2002	17	259
8/2/2002	17	231
8/27/2002	12	178
9/25/2002	10	95
10/28/2002	8	461
12/7/2002	2	398
12/29/2002	35	218
2/3/2003	7	340
3/7/2003	35	228
4/8/2003	12	274
6/4/2003	42	147
7/7/2003	9	220
8/7/2003	10	221
8/28/2003	6	71
9/29/2003	2	534
10/28/2003	24	200
12/10/2003	21	150
1/3/2004	26	139
2/3/2004	29	144
3/3/2004	28	84
4/3/2004	30	85

5/5/2004	65	115
5/15/2004	20	102
6/9/2004	12	300
6/30/2004	30	222
9/3/2004		43
10/4/2004	12	
11/3/2004	94	155
11/14/2004	26	75
11/22/2004	28	75
12/1/2004	35	72
12/21/2004	9	253

### Injection of Ozonated Water

An ozone injection pilot study was installed and began operation in December 2005 to evaluate the potential for accelerating reduction of residual PCP in the subsurface between the Site and New Cricket Spring. Injection points were located in the vicinity of the sinkhole since it is hydraulically connected to New Cricket Spring through subsurface fractures. The system operated between December 2005 and August 2009. The ozone injection system was discontinued due to equipment failures and the inability to obtain replacement parts. Significant reductions in concentration at New Cricket Spring were observed during the injection period but were stabilizing prior to the equipment failure (Table 3). The approximate average PCP concentration observed in New Cricket Springs during the operation of the injection system was 116 ppb in 2005, 36 ppb in 2006, 96 ppb in 2007, 64 ppb in 2008, and 16 ppb in 2009.

Table 3 New Cricket Spring Remediation Sampling (2005-2009)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (µg/L)
1/3/2005	10	279
2/3/2005	12	155
3/1/2005	34	208
4/4/2005	9	148
4/25/2005	6	121
5/3/2005	9	150
6/2/2005	3	151
6/20/2005	2	55
7/13/2005	2	95
8/3/2005	12	85
10/3/2005	27	63
11/3/2005	6	278

11/14/2005	6	15
11/28/2005	8	47
12/20/2005	27	7
12/26/2005	27	11
1/2/2006	21	42
1/9/2006	20	32
1/16/2006	28	32
1/23/2006	33	16
1/30/2006	41	34
2/6/2006	38	<5.10
2/13/2006	34	24
2/20/2006	21	6
2/27/2006	26	20
3/6/2006	16	25
3/13/2006	57	107
3/20/2006	48	26
3/27/2006	27	4.09J
4/3/2006	24	11
4/10/2006	16	39
4/17/2006	22	8
4/24/2006	16	7
4/27/2006	50	11
4/29/2006	193	28
5/1/2006	94	23
5/8/2006	59	52
5/15/2006	22	15
5/22/2006	16	<5.00
5/30/2006	17	6
6/7/2006	3	253
6/12/2006	2	LE
6/19/2006	17	52
6/26/2006	17	75
7/5/2006	22	10
7/17/2006	17	22
8/7/2006	17	24
8/14/2006	17	<5.00
9/5-6/2006	23	7
9/18/2006	24	6
10/2/2006	24	17
10/16/2006	41	40
10/16/2006	81	92

10/18/2006	27	118
11/7/2006	41	53
11/20/2006	24	57
11/30/2006	636	<50.0
12/4/2006	59	<54.3
12/6/2006	37	<52.6
12/18/2006	21	24
1/8/2007	21	17
1/22/2007	79	35
2/5/2007	27	26
2/19/2007	47	20
3/5/2007	27	<5.00
3/19/2007	25	NA
4/9/2007	23	<5.00
4/23/2007	30	7
5/7/2007	21	2.90J
5/21/2007	20	4.36J
6/4/2007	20	<5.00
6/18/2007	21	10
7/9/2007	20	15
7/23/2007	18	9
8/6/2007	1	191
9/10/2007	23	217
9/24/2007	18	16
10/10/2007	18	6
10/22/2007	18	1190
11/5/2007	18	209
11/19/2007	18	20
12/3/2007	18	20
12/17/2007	32	87
1/7/2008	23	<5.00
1/21/2008	23	58
2/4/2008	24	52
2/18/2008	83	57
3/3/2008	580	<5.00
3/17/2008	44	11
4/7/2008	78	10
4/12/2008	240	7
4/13/2008	100	7
4/14/2008	78	8
5/10/2008	68	75

5/27/2008	18	189
6/9/2008	30	77
6/23/2008	580	6
7/7/2008	80	194
7/10/2008	140	254
7/21/2008	42	477
8/4/2008	22	108
8/18/2008	36	31
9/1/2008	25	32
9/22/2008	40	22
10/6/2008	21	20
10/20/2008	21	13
11/3/2008	24	<5.00
11/17/2008	30	28
12/1/2008	24	12
12/22/2008	24	<5.00
1/5/2009	32	7
1/26/2009	27	<5.00
2/9/2009	90	<5.00
2/23/2009	31	6
3/9/2009	30	6
3/23/2009	30	<5.00
4/6/2009	38	6
4/20/2009	243	9
5/4/2009	343	8
5/18/2009	51	6
6/8/2009	38	<5.00
6/29/2009	25	9
7/20/2009	47	39
8/10/2009	24	31
9/13/2009	22	8
10/12/2009	104	21
11/9/2009	45	<50
12/7/2009	28	8

### Injection of Non-Ozonated Water

After equipment issues caused the discontinuation of ozone generation at the sinkhole area, non-ozonated water injection was continued. The rationale for continuing with injection of non-ozonated water was to improve operations at New Cricket Spring by maintaining a higher average water flow rate and by providing water to flush PCP concentrations. During the water injection processes, flow rates at New Cricket Spring were increased by approximately 20

gallons per minute (gpm). During low flow periods of the year, typically mid-summer and early winter, flow rates would often dwindle to less than two gpm resulting in higher ozone concentrations recirculating in the treatment equipment and accelerated decomposition of gaskets and o-rings. Maintaining the New Cricket Spring flow rate at greater than 20 gpm significantly reduced degradation of the treatment system components (Table 4).

Table 4 New Cricket Spring Remediation Sampling (2010-March 2011)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (µg/L)
1/10/2010	42	13
2/15/2010	87	11
3/15/2010	35	<5.00
4/15/2010	40	10
5/17/2010	180	11
6/13/2010	43	15
7/8/2010	33	66
8/19/2010	17	16
9/21/2010	33	28
10/18/2010	20	15
11/20/2010	21	5
12/16/2010	24	6
1/18/2011	22.83	3.39
2/9/2011	26.76	10.4
3/17/2011	49.03	14.2

During the period of April 2011 through November 2011, the non-ozonated water injection process was halted to evaluate spring concentrations without the impact of the non-ozonated water injection process (Table 5). The non-ozonated water injection process was re-started in November 2011 in response to a request from the EPA.

Table 5 New Cricket Spring Remediation Sampling (April 2011-Nov 2011)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (ug/L)
4/19/2011	57.55	12.5
5/2/2011	310	11
5/3/2011	271	8.92
5/4/2011	156	10.8
5/4/2011	123	15.8
5/5/2011	83	18
5/9/2011	33.91	43.8

6/9/2011	6.8	52.4
7/18/2011	0.575	18.6
8/15/2011	1.004	38.9
9/13/2011	0.132	<5.00
10/18/2011	23.71	52.4
11/16/2011	29.64	30.6

After re-starting the non-ozonated water injection process, analytical concentrations at New Cricket Spring returned to concentration levels approaching the ADPCE standards (Table 6).

Table 6 New Cricket Spring Remediation Sampling (Dec 2011-April 2012)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (µg/L)
12/19/2011	60.25	11.5
1/19/2012	31.82	<5.00
2/14/2012	40.38	<5.00
3/29/2012	50.81	7.95
4/18/2012	22.54	20
5/23/12	18	10.9

## Conclusions and Recommendations

It is recommended that the treatment system located at New Cricket Spring continue to operate until the PCP concentration in the spring water achieves ADEQ standards. Based on the data, it appears that the pilot injection system successfully enhanced the degradation of the residual PCP in the source area resulting in reduced concentrations emanating from New Cricket Spring. Since the current PCP concentrations are approaching the cleanup standard for PCP, it is recommended that the injection of non-ozonated water be discontinued for the next six months. During this period, make-up water can be routed from municipal or deep groundwater sources to the treatment system, as necessary, to maintain efficient treatment system operations during low flow conditions. It is recommended that analytical sampling at the mouth of New Cricket Spring continue on a monthly basis during the next ~~six-months~~year to monitor for potential rebound effects. ~~Based on the updated cleanup standard for PCP presented by ADEQ in their April 4, 2011, the monthly average concentration limit is 17.38 µg/L, and the daily maximum limit is 34.86 µg/L. Based on the Arkansas Pollution Control and Ecology Commission's water quality standard for pentachlorophenol (PCP) presented by ADEQ in their February 14, 2012 letter, the chronic standard of 15.57 µg/L is the appropriate standard for the Arkwood Site. If the analytical data indicates limited rebound (reported concentrations of less than 34.86 µg/L in any given month), monitoring would change to quarterly sampling. If analytical results measure concentrations in excess of 34.86 µg/L, injection of non-ozonated water may be reinitiated to enhance flushing operations. A summary of data and a recommendation will be submitted to the EPA at the end of the six-month~~year period.

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The need for treatment at New Cricket Spring will be evaluated, at a minimum, in the Annual Report. At such time that it is considered that the ADEQ chronic standard has been met, MMI will submit a request to the EPA for discontinuation of treatment operations.

# Arkwood, Inc. Superfund Site Groundwater Remediation Summary June 2012 (Revised August 2012)

## Site History/Record of Decision

The Arkwood, Inc. Superfund Site (Arkwood Site or Site) is a former wood treating site where wood treating fluids contaminated the soil and groundwater. The Site is located in Omaha, AR. The Site was developed in the 1950's when a railroad company excavated about 40 to 50 feet below natural grade to obtain fill dirt for constructing a railroad embankment. Arkwood, Inc. began wood treating operations at the Site in 1962 using creosote and pentachlorophenol (PCP) in its process.

In 1973, the site owner leased the wood-treating facility to Mass Merchandisers, Inc. (MMI). MMI continued to operate the Arkwood plant until June 1984. Subsequently, the remaining inventory was sold or removed from the site. In January 1985, MMI's lease expired and was not renewed. The owner dismantled the plant in 1986.

In 1985, EPA proposed that the Site be added to the National Priorities List (NPL). The Site was formally added to the NPL on March 31, 1989.

With EPA oversight, MMI conducted a Remedial Investigation and Feasibility Study (RI/FS) between 1987 and 1990 pursuant to an Administrative Order on Consent (AOC). The Regional Administrator of EPA Region VI approved the Record of Decision (ROD) for the Site on September 28, 1990.

The 1990 ROD documented that the principle threat from the Site was direct contact with soils contaminated above health-based levels. In addition, the 1990 ROD stated that these soils posed a long-term threat to groundwater. Site soils were affected with pentachlorophenol (PCP), polynuclear aromatic hydrocarbons (PNAs), and dioxin. Affected materials were defined as "all Site materials that contain greater than 300 mg/kg PCP, greater than 20 µg/kg dioxin as 2,3,7,8-TCDD equivalents (dioxin), or greater than 6.0 mg/kg carcinogenic polynuclear aromatic hydrocarbons (c-PNAs) as benzo-a-pyrene equivalents". The groundwater exits at New Cricket Spring which is located about one-quarter mile downgradient of the wood treating area. New Cricket Spring contained concentrations of PCP above the Arkansas Water Quality Standard.

In April 1991, a Consent Decree (CD) was entered between the United States of America, on behalf of the USEPA, and MMI to remediate the Site. The CD includes the ROD and a Statement of Work (SOW) as Appendices A and B, respectively, (collectively the Consent Decree). A corrected CD was entered on September 23, 1992, including the same attachments.

The soil remedy was implemented in 1994 and 1995. The remediation area is fenced with signs and locked gates.

## Post Soil Remediation Spring Sampling

As set forth in the CD and based on the results of a Dye Tracing Study, spring sampling was conducted quarterly for two years after the soil remediation was completed (Table 1).

Table 1 Post Soil Remediation Spring Sampling		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (ug/L)
7/2/1996	112	688
10/11/1996	2	651
1/20/1997	34	681
3/16/1997	34	330
7/18/1997	2	775
9/30/1997	50	560

## New Cricket Spring Treatment System

Since the PCP concentration at New Cricket Spring exceeded the cleanup level for PCP of 9.3 micrograms per liter ( $\mu\text{g/l}$  or ppb) monthly average and  $18.7 \mu\text{g/l}$  daily average set by Arkansas Department of Pollution Control & Ecology (ADPCE) at that time, an ozone pilot system was installed in April 1997. Data was collected during varying flow events and equipment settings. Based on the results, the treatment system was upgraded during November 1997 through January 1998 and a new, higher capacity system was installed during October through December 1999. The upgraded system continued to operate and to meet ADPCE requirements. Regular evaluation of the analytical data indicated the concentrations observed at the New Cricket Spring had plateaued at between approximately 75-150 ppb by 2004 (Table 2).

Table 2 New Cricket Spring Remediation Sampling (1998-2004)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (ug/L)
1/20/1998	42	561
5/7/1998	65	196
7/23/1998	3	561
11/4/1998	8	570
1/29/1999	60	288
7/12/1999	42	ND
3/8/2000	5	284
5/15/2000	2	272
6/23/2000	75	389
7/28/2000	3	627

8/20/2000	2	424
9/25/2000	1	577
10/26/2000	1	114
11/27/2000	25	632
2/26/2001	3	338
3/13/2001	3	376
4/27/2001	3	349
5/27/2001	2	388
7/27/2001	48	560
8/27/2001	6	372
9/27/2001	2	895
10/22/2001	6	275
11/30/2001	28	441
12/22/2001	60	114
1/28/2002	12	373
2/21/2002	15	372
3/8/2002	22	318
3/22/2002	42	226
4/22/2002	22	79
5/28/2002	70	71
6/26/2002	17	259
8/2/2002	17	231
8/27/2002	12	178
9/25/2002	10	95
10/28/2002	8	461
12/7/2002	2	398
12/29/2002	35	218
2/3/2003	7	340
3/7/2003	35	228
4/8/2003	12	274
6/4/2003	42	147
7/7/2003	9	220
8/7/2003	10	221
8/28/2003	6	71
9/29/2003	2	534
10/28/2003	24	200
12/10/2003	21	150
1/3/2004	26	139
2/3/2004	29	144
3/3/2004	28	84
4/3/2004	30	85

5/5/2004	65	115
5/15/2004	20	102
6/9/2004	12	300
6/30/2004	30	222
9/3/2004		43
10/4/2004	12	
11/3/2004	94	155
11/14/2004	26	75
11/22/2004	28	75
12/1/2004	35	72
12/21/2004	9	253

## Injection of Ozonated Water

An ozone injection pilot study was installed and began operation in December 2005 to evaluate the potential for accelerating reduction of residual PCP in the subsurface between the Site and New Cricket Spring. Injection points were located in the vicinity of the sinkhole since it is hydraulically connected to New Cricket Spring through subsurface fractures. The system operated between December 2005 and August 2009. The ozone injection system was discontinued due to equipment failures and the inability to obtain replacement parts. Significant reductions in concentration at New Cricket Spring were observed during the injection period but were stabilizing prior to the equipment failure (Table 3). The approximate average PCP concentration observed in New Cricket Springs during the operation of the injection system was 116 ppb in 2005, 36 ppb in 2006, 96 ppb in 2007, 64 ppb in 2008, and 16 ppb in 2009.

Table 3 New Cricket Spring Remediation Sampling (2005-2009)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (µg/L)
1/3/2005	10	279
2/3/2005	12	155
3/1/2005	34	208
4/4/2005	9	148
4/25/2005	6	121
5/3/2005	9	150
6/2/2005	3	151
6/20/2005	2	55
7/13/2005	2	95
8/3/2005	12	85
10/3/2005	27	63
11/3/2005	6	278

11/14/2005	6	15
11/28/2005	8	47
12/20/2005	27	7
12/26/2005	27	11
1/2/2006	21	42
1/9/2006	20	32
1/16/2006	28	32
1/23/2006	33	16
1/30/2006	41	34
2/6/2006	38	<5.10
2/13/2006	34	24
2/20/2006	21	6
2/27/2006	26	20
3/6/2006	16	25
3/13/2006	57	107
3/20/2006	48	26
3/27/2006	27	4.09J
4/3/2006	24	11
4/10/2006	16	39
4/17/2006	22	8
4/24/2006	16	7
4/27/2006	50	11
4/29/2006	193	28
5/1/2006	94	23
5/8/2006	59	52
5/15/2006	22	15
5/22/2006	16	<5.00
5/30/2006	17	6
6/7/2006	3	253
6/12/2006	2	LE
6/19/2006	17	52
6/26/2006	17	75
7/5/2006	22	10
7/17/2006	17	22
8/7/2006	17	24
8/14/2006	17	<5.00
9/5-6/2006	23	7
9/18/2006	24	6
10/2/2006	24	17
10/16/2006	41	40
10/16/2006	81	92

10/18/2006	27	118
11/7/2006	41	53
11/20/2006	24	57
11/30/2006	636	<50.0
12/4/2006	59	<54.3
12/6/2006	37	<52.6
12/18/2006	21	24
1/8/2007	21	17
1/22/2007	79	35
2/5/2007	27	26
2/19/2007	47	20
3/5/2007	27	<5.00
3/19/2007	25	NA
4/9/2007	23	<5.00
4/23/2007	30	7
5/7/2007	21	2.90J
5/21/2007	20	4.36J
6/4/2007	20	<5.00
6/18/2007	21	10
7/9/2007	20	15
7/23/2007	18	9
8/6/2007	1	191
9/10/2007	23	217
9/24/2007	18	16
10/10/2007	18	6
10/22/2007	18	1190
11/5/2007	18	209
11/19/2007	18	20
12/3/2007	18	20
12/17/2007	32	87
1/7/2008	23	<5.00
1/21/2008	23	58
2/4/2008	24	52
2/18/2008	83	57
3/3/2008	580	<5.00
3/17/2008	44	11
4/7/2008	78	10
4/12/2008	240	7
4/13/2008	100	7
4/14/2008	78	8
5/10/2008	68	75

5/27/2008	18	189
6/9/2008	30	77
6/23/2008	580	6
7/7/2008	80	194
7/10/2008	140	254
7/21/2008	42	477
8/4/2008	22	108
8/18/2008	36	31
9/1/2008	25	32
9/22/2008	40	22
10/6/2008	21	20
10/20/2008	21	13
11/3/2008	24	<5.00
11/17/2008	30	28
12/1/2008	24	12
12/22/2008	24	<5.00
1/5/2009	32	7
1/26/2009	27	<5.00
2/9/2009	90	<5.00
2/23/2009	31	6
3/9/2009	30	6
3/23/2009	30	<5.00
4/6/2009	38	6
4/20/2009	243	9
5/4/2009	343	8
5/18/2009	51	6
6/8/2009	38	<5.00
6/29/2009	25	9
7/20/2009	47	39
8/10/2009	24	31
9/13/2009	22	8
10/12/2009	104	21
11/9/2009	45	<50
12/7/2009	28	8

## Injection of Non-Ozonated Water

After equipment issues caused the discontinuation of ozone generation at the sinkhole area, non-ozonated water injection was continued. The rationale for continuing with injection of non-ozonated water was to improve operations at New Cricket Spring by maintaining a higher average water flow rate and by providing water to flush PCP concentrations. During the water injection processes, flow rates at New Cricket Spring were increased by approximately 20

gallons per minute (gpm). During low flow periods of the year, typically mid-summer and early winter, flow rates would often dwindle to less than two gpm resulting in higher ozone concentrations recirculating in the treatment equipment and accelerated decomposition of gaskets and o-rings. Maintaining the New Cricket Spring flow rate at greater than 20 gpm significantly reduced degradation of the treatment system components (Table 4).

Table 4 New Cricket Spring Remediation Sampling (2010-March 2011)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (µg/L)
1/10/2010	42	13
2/15/2010	87	11
3/15/2010	35	<5.00
4/15/2010	40	10
5/17/2010	180	11
6/13/2010	43	15
7/8/2010	33	66
8/19/2010	17	16
9/21/2010	33	28
10/18/2010	20	15
11/20/2010	21	5
12/16/2010	24	6
1/18/2011	22.83	3.39
2/9/2011	26.76	10.4
3/17/2011	49.03	14.2

During the period of April 2011 through November 2011, the non-ozonated water injection process was halted to evaluate spring concentrations without the impact of the non-ozonated water injection process (Table 5). The non-ozonated water injection process was re-started in November 2011 in response to a request from the EPA.

Table 5 New Cricket Spring Remediation Sampling (April 2011-Nov 2011)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (ug/L)
4/19/2011	57.55	12.5
5/2/2011	310	11
5/3/2011	271	8.92
5/4/2011	156	10.8
5/4/2011	123	15.8
5/5/2011	83	18
5/9/2011	33.91	43.8

6/9/2011	6.8	52.4
7/18/2011	0.575	18.6
8/15/2011	1.004	38.9
9/13/2011	0.132	<5.00
10/18/2011	23.71	52.4
11/16/2011	29.64	30.6

After re-starting the non-ozonated water injection process, analytical concentrations at New Cricket Spring returned to concentration levels approaching the ADPCE standards (Table 6).

Table 6 New Cricket Spring Remediation Sampling (Dec 2011-April 2012)		
Date	New Cricket Spring Flow Rate (GPM)	New Cricket Spring PCP Concentration (µg/L)
12/19/2011	60.25	11.5
1/19/2012	31.82	<5.00
2/14/2012	40.38	<5.00
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5/23/12	18	10.9

## Conclusions and Recommendations

It is recommended that the treatment system located at New Cricket Spring continue to operate until the PCP concentration in the spring water achieves ADEQ standards. Based on the data, it appears that the pilot injection system successfully enhanced the degradation of the residual PCP in the source area resulting in reduced concentrations emanating from New Cricket Spring. Since the current PCP concentrations are approaching the cleanup standard for PCP, it is recommended that the injection of non-ozonated water be discontinued for the next six months. During this period, make-up water can be routed from municipal or deep groundwater sources to the treatment system, as necessary, to maintain efficient treatment system operations during low flow conditions. It is recommended that analytical sampling at the mouth of New Cricket Spring continue on a monthly basis during the next year to monitor for potential rebound effects. Based on the Arkansas Pollution Control and Ecology Commission's water quality standard for pentachlorophenol (PCP) presented by ADEQ in their February 14, 2012 letter, the chronic standard of 15.57 µg/l is the appropriate standard for the Arkwood Site. A summary of data and a recommendation will be submitted to the EPA at the end of the year period.

The need for treatment at New Cricket Spring will be evaluated, at a minimum, in the Annual Report. At such time that it is considered that the ADEQ chronic standard has been met, MMI will submit a request to the EPA for discontinuation of treatment operations.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY  
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION  
P.O. Box 1198 Ada, OK 74820

August 15, 2012

OFFICE OF  
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Arkwood Superfund Site (12-R06-002) *[Signature]*  
FROM: Scott G. Huling, Environmental Engineer  
Applied Research and Technical Support Branch  
TO: Ruben Moya, Remedial Project Manager  
Stephen L. Tzhone, Remedial Project Manager  
Superfund Division  
EPA Region 6, Dallas TX

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A technical review was conducted on the documents entitled, "Final Report Groundwater Tracing Investigation, Arkwood Inc. Site, Omaha, AR. Comments and recommendations are included below. If I can be of assistance to you, please call me at (580) 436-8610.

cc: Linda Fiedler (5203P)  
Terry Burton, Region 6  
Gregory Lyssy, Region 6  
Vince Malott, Region 6  
Chris Villarreal, Region 6

## **Technical Review Comments and Recommendations:**

### **General Comments**

1. Pgs. 17-19. The conditions of injecting the dye liquid at injection locations 91-01 and 91-02 indicate that the dye was injected along two losing sections of the river. For example, at tracer location 91-01, it was reported that 10 truckloads of 1800 gallons each of fluorescein and Rhodamine WT dye were discharged along the stream channel of Cricket Creek at a rate of 95 gallons per minute (21,600 gallons total). The 91-02 tracer test was performed along the same creek down by the New Cricket Spring where more dye was released. In both cases, the dye infiltrated the ground within a short transport distance.

It was reported that the purpose of the study was designed to identify all springs in topographic basins, other than Cricket Creek and Walnut Creek that receive recharge waters from the site. Further it was reported that the purpose of the test was not to assess movement of water through the "residuum and the subcutaneous zone". It is assumed that this refers to the ground water movement in the near surface where contaminant transport from the site originates. However, this appears to be a flaw in the use of the tracer test as it relates to the issue raised in the previous technical review memorandum (June 27, 2012). Specifically, the technical issue raised in that correspondence was that PCP-contaminated ground water, emanating from the contamination site, is not captured by New Cricket Spring and migrates beyond New Cricket Spring. Based on a preliminary understanding of the waste handling at the site, the majority of the wood preserving waste was historically placed into the on-site sinkhole, i.e., released into the subsurface, and then dissipated with time. It is reasonable to conclude that the release of the dye along the stream channels does not simulate contaminant transport from the site where the majority of the contamination was released/disposed.

It is recommended that a fate and transport investigation be conducted to assess the extent to which contaminated ground water may be leaving the site. This may require additional site characterization activities to fill data gaps. In context with the tracer test that was previously conducted, please clarify whether contaminated ground water from the site discharges to the subsurface along the losing sections of the stream where the dye was injected. Finally, it is recommended that an assessment be performed to determine whether New Cricket Spring captures all the contaminated ground water from the site.

2. Pg. 20. It was reported that "The injection sites bracketed the Arkwood Site thus ensuring that all flow systems from the site would be traced." Based on the results of these tests, dye was detected at 12 locations downgradient/downstream from the dye injection location 91-01, and from 14 locations downgradient/downstream from the dye injection location 91-02. This result indicates that the New Cricket Spring does not capture all ground water emanating from the site.

### **Specific Comments**

1. In a response letter from McKesson (August 9, 2012), it was reported that,

“Although a portion of the water that flows beneath the Arkwood site may not flow through the New Cricket Spring, no detectable PCP concentrations are measurable at other potential discharge locations.”

There is significant uncertainty in the fate and transport of wood preserving wastes associated with this site. As indicated in general comment no. 1 above, it is recommended that additional site characterization and a fate and transport investigation be conducted to assess the extent to which PCP-contaminated ground water may be transported beyond the property boundary of the Arkwood site. Specifically, it is recommended that “other discharge locations” be identified as they relate to the contaminated ground water.

2. In a response letter from McKesson (August 9, 2012), it was reported that,

“The area is underlain by karst geology which prevents the use of monitor wells as a method of predicting contaminant movement, or recovery wells as a method of remediation.”

It is agreed that predicting contaminant fate and transport in the subsurface is challenging. However, it should not be precluded that sites described as karst overlain by unconsolidated materials cannot be characterized using monitoring wells or remediated using recovery wells.